Chapter 20

Importance of Alpacas and Llamas in the Changing Context of Development Research

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Introduction

Lamoids (also called cameloids) are ruminants native to South America that belong to the same family as camels but are smaller and humpless. There are two domesticated species, the llamas and alpacas, and two wild species, the vicuna and guanaco.

Lamoids have played a critical role in the Andean agroecosystem ever since they were domesticated, at the same time as plants. In the cold Andean highlands and parts of the Pacific Coast, alpacas became the most important source of wool. Llamas, a secondary provider of wool, became the most efficient pack animal, facilitating transportation of goods over long distances. In traditional villages, both species are still a very important source of dung both for manure for agriculture and for fuel. Although meat has always been considered of secondary importance in the Andean diet, salted and freeze-dried lamoid meat is an occasional but important source of high quality protein.

Lamoid bones provide the main material for work utensils and beautifully crafted items, while sinews are turned into thongs. Lamoid lard, in addition to the health properties acknowledged in the rich Andean medical lore, played and plays an important role in religious ritual. Lamoid foetuses resulting from natural abortion – a common trait of South American lamoids (SALs) – are sold in rural markets and widely used in fertility rites. Similarly, stone formations in the SALs' digestive

system – bezoares – are considered to be charms and are believed to have magical properties.

Literature on the nutrition of llamas (*Lama glama*) and alpacas (*Lama pacos*) indicates that these animals are better adapted to the harsh environment of the Andean region than other domestic ruminants. With their outstandingly efficient digestive system, alpacas and llamas can survive on coarse native grasses, wire sedges, and rushes. Thus, in contrast to sheep and cattle, they require no pasture improvement or other modifications of the unique, high altitude environment. They even thrive on sites where phosphorus and copper are so severely lacking that sheep and cattle suffer from debilitating deficiency diseases.

Species of Lamoids

The llama (*Lama glama*) is the most cosmopolitan member of the SALs. Nowadays they are kept at elevations between 2,600 and 4,800 masl, and are found from south Colombia, to Ecuador, Peru, Bolivia, Chile, and Argentina. Alpaca (*Lama pacos*) rearing is restricted to elevations of 3,850m and above in Peru, Bolivia, and Chile. The zone of the greatest population and productivity lies along the Andean Cordillera between 11° S and 21° S. The number of these animals in different countries in South America is shown in Table 20.1. There are currently 6,500,000 in all; the largest number of alpacas are found in Peru and the largest number of llamas in Bolivia. Smaller populations are found in Chile, Argentina, and Ecuador, where alpacas have very recently been reintroduced, and there is a small population of llamas. Despite their relatively small numbers, domesticated lamoids play a significant role in the economy of the high Andean regions of Peru, Bolivia, Chile, and Argentina.

The two domesticated species and the two wild lamoids – guanacos and vicuna – are described in more detail below.

Table 20.1: **Estimated population of alpacas and llamas in the Andean region**

Country	Alpacas	Llamas
Argentina	400	135,000
Bolivia	324,336	2,022,569
Chile	27,585	70,363
Ecuador	2,085	9,687
Peru	2,900,900	1,006,574
Total	3,255,306	3,244,193

Source: Hoces 1997

Alpaca

The alpaca is smaller than the llama, has short and pointed ears, a woolly face, and a rounded rump. The average height at the wither ranges from 80 to 90 cm; adult males weigh from 55 to 60 kg and females 47 to 57 kg.

Centuries of selective breeding for wool quality (usually called 'fibre' to differentiate it from sheep's wool) have produced two breeds of alpaca, which are distinguished on the basis of their fibre characteristics. The Huacaya breed produces shorter crimped fibres that give the wool a spongy appearance resembling that of the Corriedale sheep. The wool of the Suri breed is characterised by long straight fibres arranged in locks that fall to each side of the body in much the same manner as those of Lincoln sheep.

There is a considerable variation in the quantity of fibre produced by the alpaca, from as little as 0.9 kg to as high as 4.0 kg per animal per year. The average fleece weight is 1.8 kg per animal per year in Huacayas and 1.9 kg in Suris. The average fleece fineness in different breeds of alpacas is 24 lm. The Suri breed is essentially found only in Peru and represents no more than five per cent of the total alpaca population.

As a result of the difficulty in separating multicoloured wool, breeding selection aims at solid colours. Pure white or light fawn are the most abundant colours in Peru (57%) and the most prized, but other colours such as brown, black, grey, and roan are also valued.

Llama

The llama is the largest of the four species. Males stand at about 1.05 to 1.10m and females 0.95 to 1.05m. The average body weight of the adult male ranges from 80 to 90 kg and that of females from 75 to 85 kg. The ears are long and curved and the face is free of wool, with a long, straight to slightly rounded, nose. The back is flat from the shoulders to the rump, ending in a tail that curls up and back. From the time of the Incas, llamas have been used as beasts of burden.

There are two breeds, the Pelada (also known as Kara or Lutica) and the Lanuda (also known as Chaku, Tajulli, or Tampully). Approximately 20% of animals are the 'intermediate type', that is the result of crosses between animals of both breeds. The woolly type or Lanuda has a thicker fleece all over the body, including the neck and proximal portions of the front and hind legs, with a slight crimp and uniform and soft-to-the-touch fibres. Recent studies reported that the average fibre diameter is 28.0 lm with a high coefficient of variation (43.5% - 57.7%). The fibre length varies

from 5 to 21 cm according to the time of growth. Traditionally, these animals are sheared every two years or at even longer intervals, but they can be sheared each year. The average fleece weight is around 1.3 kg per animal per year, but selected animals under good management conditions can produce 4.0 kg a year. The Kara has a less abundant fleece, especially around the face, neck, and legs. There are two easily identified layers of fibre: the 'undercoat' (or 'innercoat') formed by fine wool fibres of small diameter and length (average diameter 25 lm), and the 'outercoat' formed by a layer of longer coarse thick fibres (average fibre diameter 87.0 lm). The wool fibre fineness and length varies considerably. Generally these animals are sheared every three to four years, but annual shearing can produce 0.94 kg of wool.

Overall (both breeds) the fibre thickness ranges from 8 to 144 lm (a high coefficient of variation), reflecting the great variability that exists among different animals of the same breed and between animals of different breeds. This is the result of a lack of selective breeding and uncontrolled crosses between the two breeds (intermediate type). In both breeds, the coat colour can be white, brown (different shades), grey, or black. There is a high percentage of multicoloured animals – spotted or patched.

Vicuna

The vicuna (*Lama vicugna*) is a wild species and is the smallest of the SALs. It is only found in the puna life zone of the Andes, where it is most common at elevations of 4,200-5,200m, with a lower limit of 3,700m. At present, the northernmost distribution of the vicuna is 9°30'S in the department of Ancash, Peru, and the southernmost limit is 29°0' in the province of Atacama, Chile. There are an estimated 104,300 in Peru; 33,800 each in Bolivia and Argentina; and 19,800 in Chile.

The vicuna is a slim, elegant animal with a shoulder height of approximately 80 cm and an average body weight of 35 kg. The head is small with large black eyes, the neck is long and thin, and it has an extremely lively and agile nature. The fleece is characterised by a short growth of extremely fine woòl (average thickness12 lm), cinnamon-coloured over the main body with white underparts. The vicuna has the unique characteristic of having a large hank of white fibre on the chest that is longer and much thicker than the fibres on the rest of the body. Its incisors continue to grow almost throughout its lifetime, another distinctive feature that enables the animal to eat tough forage plants that are rich in silicic acid as well as to take very small plants that are close to or lie directly on the ground. Apart from the distinctive teeth, the vicuna has other anatomical and physiological characteristics that enable it to survive in the inhospitable high altitude puna environment more successfully than any domestic animal. These include the extraordinarily fine and thick fleece, an

unusually low energy requirement, and the surprisingly high weight of newborn animals.

Guanaco

The guanaco (*Lama guanicoe*) is the other wild member of the SALs. It lives in a wide variety of wild habitats, unlike other SALs. It thrives from sea level up to 4,500m in both humid and arid zones. It is found in an area that extends from the northern part of Peru (8°S) through the pre-cordillera and coastal areas of northern Chile to Tierra del Fuego, the southernmost region of Argentina and Chile. The largest population inhabits the pampa, or cold steppe, where 'coiron' is the predominant vegetation. The greatest number are found in Argentina (estimated at 579,000) followed by Chile (25,000).

The guanaco is more or less the same size as the llama and weighs between 80 and 120 kg depending on the geographic subspecies, of which four have been described. All four subspecies have the same colour pattern, a light brown upper body, whitish underbelly, and blackish face. The guanaco has always been hunted for its meat and for the fur of young animals, called chulengo, which is mainly sold for export. In the adult animal, the fleece is composed of two layers: an internal or undercoat which is very fine and short; and an external or outer coat which is longer and coarser. Guanacos live in both migratory and sedentary groups. Family bands consist of one adult male and five to six adult females with their young; some occupy permanent territories that the male defends against all other guanacos. Young males unite into migratory troops of up to 50 individuals, but around 8% of the total population remains solitary, challenging the dominant males for control of their family groups and territories, especially during the breeding season. Guanaco populations have been drastically reduced since the arrival of the Spanish, and little has been done to protect this endangered species. It has been suggested that guanacos might be kept with sheep since most of their feed comes from browsing on stunted shrubs and thus there is no competition for grazing.

Genetic diversity

The South American domestic lamoids bred in different areas are sometimes given local names but most are not actually breeds. Recently, the genetic make up of South American lamoids from Bolivia, Peru, and Chile was studied in a survey. The breeds found in the three countries, their main regional names, and their percentage contribution to the total population in each country are summarised in Table 20.2. The survey drew the following conclusions.

- Chile has one breed of alpaca, the Huacaya, and two breeds of llama, the Lutica (or Pelada), and the Tajulli (or Lanuda).

Table 20.2: **Occurrence and regional names of the different breeds of alpacas and llamas**

Country	Alpaca breeds		Llama breeds	
	Huacaya local name	Suri local name	Pelada local name	Lanuda local name
Bolivia	Huacaya (nearly 100%)	Suri (a very few)	Kcara, K'ara (80%)	Tampulli, T'hampully (20%)
Chile	Huacaya (100%)	(none)	Lutica (60%)	Tajulli (40%)
Peru	Huacaya (95%)	Suri (5%)	Kara (80%)	Chaku (20%)

- Bolivia also has effectively only one breed of alpaca, the Huacaya, (although there are a very few Suri breed in the northern part of the country close to the Peruvian border), and two breeds of llama, the Kcara or K'ara (or Pelada) and the Tampulli (or Lanuda).
- Peru has two breeds of alpaca, the Huacaya and the Suri, and two breeds of llama, the Kara (or Pelada) and the Chaku (or Lanuda).
- Approximately 20% of the llamas in the three countries are 'intermediate breed or type', that is the result of crosses between animals of both breeds. In the survey, these animals were classified as belonging to the Pelada breed. There are no phenotypic intermediate types of alpacas.
- The predominant colour of alpacas is different in the different countries. In Peru, the most frequent solid colour (unicoloured) in both breeds is white, followed by different shades of brown, black, grey, and roan. Patched animals (with two, or very rarely three, colours) comprise 14% of the total population of both breeds. In Bolivia and Chile, the predominant colour is brown (in different shades), followed by black, white, grey, and roan. Patched animals comprise 18 and 14% of the populations, respectively. The grey colour (in different shades) is actually a mixture of white and black hairs in the fleece; the roan colour is a mixture of white and brown hairs in the fleece. The shade of grey or roan depends on the quantity of white hairs in the fleece.
- There is a similar variation in the colour of llamas. In Peru, the most frequent solid colour (unicoloured) is white (33%), followed by brown, grey, and black. Patched animals (two colours) comprise 31% of the total population. In Bolivia, dark colours, such as brown and black, are abundant, followed by white (11%) and grey (9.5%). In Chile, the solid white is the most abundant (12%) followed by brown and grey. Patched animals comprise 43% of the total population in Bolivia and 69% in Chile. In Bolivia, there is some variation in size, conformation, and fleece characteristics of llamas, but there are no types that are recognised as being distinct. The variation here is probably greater than elsewhere, but no local strains have been described.

Variation or genetic diversity is the raw material that the breeder has available for herd or flock improvement. Both heredity and environment are important in

producing differences among individuals, and in some cases this variation is the result of their joint action or interaction. By studying variation alone, we cannot determine which part is the result of heredity and which environment. The relative importance of hereditary and environmental influences in the variation of individual traits has been determined by other means in other domestic species, but not in alpacas or llamas.

Currently, most of the small herds of alpacas and llamas are kept by a single family of people, and male animals are used for years, with minimal or no rotation, leading to inbreeding and a reduction in genetic diversity, as well as other resultant problems. Overall. however, the Andean region contains numerous genetically different populations of alpacas and llamas, populations that have been geographically isolated, thus increasing the genetic diversity. Recently, renewed interest has been shown in the preservation of genetic variation in livestock. This has mainly come from the desire of breeders and geneticists to store the genes or 'germplasm' of minority breeds, some of which were on the verge of extinction. Germplasm can be stored in the form of semen (the haploid state), fertilised ova (the diploid state), or live animals kept at zoological gardens, in National Parks, on privately-owned game ranches, or elsewhere. In Peru, we know of at least three state farms where an attempt is being made to increase the population of alpacas or llamas of a particular colour whose numbers are very low.

Lamoids in the Andean Agropastoral Farming System

Domesticated cameloids play a critical role in the traditional subsistence strategy. Their high and cold habitat has a limited net production of biomass. Despite the crucial domestication of plants for human consumption, no crops grow over 4,300m. Thus, in contrast to cattle and sheep, cameloids do not compete with agriculture for land since they normally graze on pastures above the limits of agriculture, or on agricultural plots under fallow.

The dung from SALs is an essential part of the agricultural system. Dung enables an effective transfer of energy from grazing areas into agricultural plots. This transfer is accomplished either by allowing the animals to graze on land in fallow, or by collecting dung manually and spreading it on the fields prior to ploughing.

The dung cake from SALs is called 'taquia' and is a very important cooking fuel at high altitudes where firewood is scarce or non-existent. It burns well and has high heating properties. Currently, kerosene is used widely for cooking in the Andes. However, it is too expensive for the poor 'campesinos' (peasants). Reforestation with native Andean trees and shrubs that have a potential as firewood has been promoted

in some areas. However, because of the slow growth of plants at high altitude, this provides few benefits in the initial stages. Nowadays, it is not uncommon to see small industrial activities, such as bakeries, in highland villages that are based on the intensive use of taquia bought cheaply from landless herders.

Transportation of goods on llama back represents an efficient as well as cheaper and more appropriate alternative to vehicles, which are particularly costly on steep and winding roads. This is especially true for self-subsisting peasants with little access to cash. The advantages became particularly evident during the oil crisis of 1968 when fuel prices went up dramatically and there was a resurgence of llama caravans in certain regions of the Central Andes. During the rainy season landslides cut off highland roads, which again provides an opportunity for llama herders to provide their services at good rates. Each llama can carry a load of 25 to 30 kg over distances of 20 to 25 km per day, and a llama caravan may be as big as 100 to 120 animals. A whole caravan can be handled by one or two persons. On their way the animals feed on wild grass and natural fodder.

The fibre market may also be analysed from the perspective of energy flow. Wool from SALs provides an efficient means of energy conservation through its use as clothing, and in addition it commands a good price in the market. In many cases, particularly in highland communities with little or no access to agricultural land or off-farm employment opportunities, the wool market is the only source of cash income. In these highland communities, cash is converted into much needed additional food energy and other supplementary nutritional requirements. (The highland diet is deficient in iodine, which can be obtained through consumption of dry sea kelp, and in certain vitamins, calcium, and others, most of which can be obtained in some form through trade and barter or at the rural markets). SALs also provide a direct source of food. Both llamas and alpacas yield significant amounts of fibre and meat as shown in Table 20.3.

SALs offer other benefits, too. As with other forms of livestock in rural societies, SALs function as a way of accumulating a capital reserve that can be easily and

Table 20.3: **Production parameters for llamas and alpacas**

Species	Llama	Alpaca
Natality, %	47	45
Mortality at birth	25	30
Adult mortality, %	8	10
Adult live weight kg	90	50
Carcase yield, %	55	54
Extraction, %	10	12
Fibre weight, kg	2.0	1.6
Frequency of shearing (per year)	3	1.5

Source: FIDA 1990

readily converted into cash when needed. And finally, the use of children to perform herding tasks contributes significantly to an energetically efficient strategy for the division of labour at high altitude. The efficiency of an agropastoral family is related to the number of children over six years old, the age after which they can take care of animals.

Herding lamoids together with cattle and sheep

Nowadays SAC herders can be characterised as 'poly-pastoral'. Although lamoids constitute the dominant species among traditional herders, there is always a place for sheep and cattle, depending on the region and altitude. Throughout the puna it is quite common to run into mixed herds of lamoids and sheep. In general alpacas are the most numerous species in mixed herds (from 30 to 120 alpacas) because of the value of their fibre. They are followed by ovines (10 to 80) and llamas (5 to 50). Occasionally, the herder may have two or three cows and possibly a bull, either kept separately in corrals or sometimes allowed to graze with the rest of the herd. The proportion of different species in mixed herds varies from region to region. In northern Chile, for example, llamas dominate together with sheep (Gundermann 1984).

Handling a mixed herd is more complicated than having a herd of lamoids only. The latter can be managed by one herder – even in large numbers – because of their docility and habit of following a leader. Sheep require much more concentration. In many cases dogs are used to help with sheep. Finally, when bovines graze together with the herd, they are fastened with ropes to stones or poles to prevent them dispersing.

Mixed herding, in addition to the sanitary risks, can affect the status of pastures. Sheep grazing patterns have been seen to seriously affect the short and slow growing highland pastures. Little research has been done on the effect of mixed herding on pastures compared to pure lamoid herding, but given the lower productivity of sheep compared to SALs at high altitudes, it seems likely that mixed herds will lead to more overgrazing than unmixed ones. Appropiate alternatives for mixed herding should be based on sound agrostological [systematic study of grasses, ed.] research and adequate rangeland and herd management. Each animal species also has preferences for certain pastures, a factor that can be taken into account in order to optimise the use of the highland prairies. In the long run, it is better to have an adequate balance in the consumption of the different grasses than to have degraded pasturelands.

Conclusions

There are large numbers of people living in high altitude ecosystems (in the Andes, Himalayas, and others), and they all need animals for subsistence since crop

production is not possible. The Andean people domesticated the llama and alpaca, and the Himalayans the yak (*Bos grunnensis*). Alpacas and llamas (the domesticated SALs) are remarkable animals upon which millions of the poorest people in Latin America depend for their survival.

SALs are native to high altitudes. They are used to living in a fragile ecosystem, with constant exposure to cold, heat, and intense solar radiation (ultraviolet), and surviving on a coarse dry diet. Most llama and alpaca production occurs under such conditions. Domestic cameloids constitute the most reliable breeding animal in the highlands or punas of the Andes. Introduced species like sheep, goats, and cattle adapt poorly to the environmental stresses of the high altitude regions and give reduced yields of inferior quality, even after almost five centuries of acclimatisation.

Biological research over the past 30 years has clearly documented the productive superiority of llamas and alpacas at high elevations and in harsh environments. Lamoids could undoubtedly be raised even more profitably on better quality pastures and in less harsh environments. Recent introductions of alpacas and llamas into the United States, Israel, Canada, and New Zealand, have shown that these animals can be reared in areas outside the Andes with successful commercial production.

There is worldwide concern about environmental degradation and unsustainable agriculture. Llamas and alpacas offer potentially big advantages in the fragile-high-altitude ecosystems since they are possibly the most environmentally gentle ruminant livestock in the world. With their soft-padded feet, they do not scour steep hillsides. With their sharp front teeth, they clip off grass rather than tear it off like sheep and cattle. Moreover, with their outstandingly efficient digestive system, they can survive on coarse native grasses. Thus, in contrast to sheep and cattle, they require no pasture improvement or other modification of the unique, high-altitude environment and they are able to utilise marginal pastureland that would otherwise be ungrazed, or improperly used, thus causing damage to the ecosystem.

In order to increase animal production in the last fifty years, impoverished countries of the developing world have imported different livestock species from temperate developed zones, usually with disappointing results. High-yielding cattle, or sheep that produce fine wool, used to high quality balanced diets and high-tech management in their countries of origin, are unable to perform to the expected level when confronted by poor feeding conditions, improper management, parasitism, and difficult climatic environments. The problems with exotic stock have already been recognised to some extent. People are realising that the benefits are fewer than expected; that introduction of exotic (lowland) stock is often based on the use of modern technical resources, like freezing of semen and embryos, that are not

available; and that the introduced stock lack resistance to local diseases and the sturdiness needed for survival under poor conditions. Nowadays there is a tendency to avoid introducing pure-bred exotic domestic animals, particularly in environments already sensitive to ecological degradation. Instead of introducing exotic breeds from lowland areas, it would make more sense to transplant domestic species that are adapted to harsh and high altitude environments.

In the late 1970s, the UN Food and Agricultural Organization defined the ideal animal of the future. The animal, said FAO, should be a ruminant, should need little water, should be highly fertile, and should provide people with protein and other products. The llama and alpaca fit that ideal choice. To find the animal of the future, people need to look no further than lamoids.

When all the advantages are considered, lamoids would appear to offer a good substitute for the sheep presently grazing the vast arid lands of the developing world with marginal profitability. The llama's adaptation to the forage and water supplies present in high arid lands, its nutritious meat, the wool used by artisans and the modern textile industry, and their overall hardiness and adaptability, make them 'super species' with fascinating qualities and global utility. Llamas do not compete with native sheep or cattle for grazing areas, and complementary grazing should be considered in potential recipient areas such as the Himalayan rangelands. Lamoids need water much less frequently than other domestic species and so can be kept in places where the water supply is scarce. Lamoids can be integrated easily into the farming and economic system of traditional rural villages because rearing costs very little in terms of labour and technology. The medium fine quality llama wool, can be used in the local production of tapestry and garments. Also, the animals can be used as beasts of burden for transporting goods over rugged mountains and provide nutritious meat for the owners.

One point should be observed, however. When lamoids are introduced to an area, special care must be taken to prevent transmission of infectious diseases from local livestock and intoxication from some plants. Otherwise there should be no serious problems if the animals are managed according to our recommendations and common sense.

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